VTT Technical Research Centre of Finland

AI Awareness in Machine System Design

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AI in machine systems

In industrial machine systems, AI technologies are used e.g. in image processing and object recognition tasks. Further uses include various optimization and condition monitoring applications. In the future, increasingly advanced autonomous decision-making capability and adaptive behaviour is targeted. This can increase productivity, but also makes the system more complex for humans working with the system.

AI Awareness

AI Awareness (Karvonen et al., 2019) is a proposed human factors concept building upon the concepts of situational awareness and automation awareness. AI awareness consists of a worker's:

- Perception of the current decision made by the AI
- Comprehension of this decision
- Ability to estimate the decisions by AI in the future

Concept design

- AI Awareness should be considered right from the beginning of design process
- Definition and documentation of human-AI interactions in the system concept
- Broad system description needed, incl. all potential stakeholders that may interact with the system and the types of these interactions

Architecture design

- Definition of principles for data collection and handling
- Documentation of the data-related procedures, to provide the user sufficient information regarding the amount and quality of data used to train the system

Detailed design, implemetation & integration

- Implementation considering communication capability and transparency
- Interface design to enable intuitive communication between humans and AI
- Designing methods for displaying the AI's decision-making rationale to the system users
- Properly designed communication and trasparency enable user's trust in the AI system

Operation & maintenance

- Ensuring that all users have the sufficient skills to operate the system
- Change management procedures considering maintenance of AI system, e.g. when repurposing to a new operating environment

System verification and validation (V&V)

- Challenging task, as standardization is only starting to develop
- Simulator-based V&V, involving the actual user of the system
- Consider also other tasks that the users of the system may need to handle simultaneously

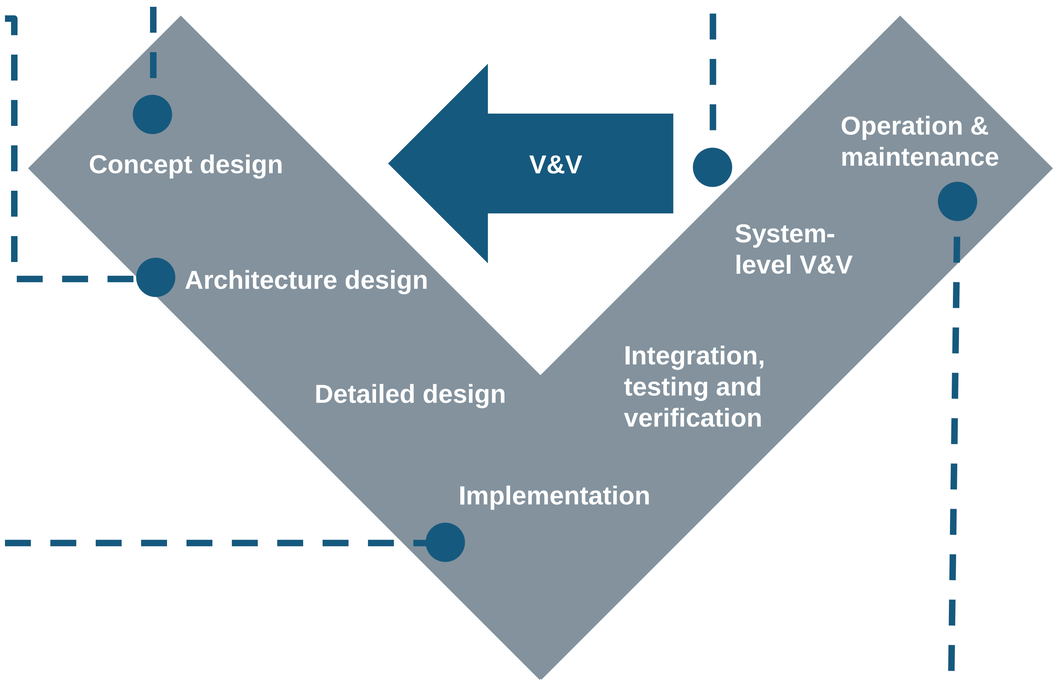

Figure 1. *A generic systems engineering V-process, with descriptions of AI Awareness considerations for different design phases.*

Conclusions

- **AI can be applied in machine systems for various tasks. Whenever applied, AI development should be considered as an integral part of the system design.**
- **AI Awareness is a concept that can help in addressing user-related and human factors challenges of AI.**
- **AI Awareness aspects should be considered in all phases of system design to ensure safe co-operation between humans and AI.**

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